(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 724 237 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
17.04.2002 Bulletin 2002/16

(51) Int Cl.[7]: **G07D 5/08**

(21) Application number: **96300547.5**

(22) Date of filing: **26.01.1996**

(54) **Coin sorting machine**

Münzsortiervorrichtung

Machine pour trier des pièces de monnaie

(84) Designated Contracting States:
BE DE FR GB IT NL

(30) Priority: **27.01.1995 JP 4608895**

(43) Date of publication of application:
31.07.1996 Bulletin 1996/31

(73) Proprietor: **ASAHI SEIKO KABUSHIKI KAISHA**
Minato-ku Tokyo (JP)

(72) Inventors:
- **Takayama, Shigeki**
  Iwatsuki-shi, Saitama (JP)
- **Ohtomo, Hiroshi**
  Iwatsuki-shi, Saitama (JP)

(74) Representative: **Schlich, George William et al**
Mathys & Squire
European Patent Attorneys,
100 Gray's Inn Road
London WC1X 8AL (GB)

(56) References cited:
EP-A- 0 202 378
EP-A- 0 392 110
WO-A-91/03032
WO-A-93/04448
US-A- 4 995 497

EP 0 724 237 B1

Description

[0001] The present invention relates to coin sorting machines built into various apparatus, such as vending machines, money-changing machines, and game machines, which are operated with a coin or coins loaded into them, and, more specifically, to a coin sorting machine that electronically detects the size and material of coins to sort them out.

[0002] Some types of coin sorting machines are conventionally known which determine whether to accept a coin inserted, depending on changes in impedance of a circuit generated when the inserted coin blocks the magnetic flux developed by a coin sorting coil.

[0003] Such a coin sorting machine is found in U.S. Patent No. 3,870,137 (hereinafter referred to as the "first prior art"), and in EP-A-0 202 378.

[0004] In the first prior art, its main objective is to sort coins formed with thin pieces of different materials laminated (laminated coin), such as dimes (10 cents) and quarters (25 cents). To sort such laminated coins, it is necessary to detect both materials of the coin, i.e., its inner material and outer skin material.

[0005] For that purpose, the first prior art utilizes the fact that although the magnetic flux generated by a relatively low frequency penetrates into the coin, the magnetic flux generated by a relatively high frequency penetrates only the skin of the coin. More specifically, according to the first prior art, a plurality of oscillators are oscillated at relatively low and high frequencies, thereby allowing for the detection of inner and skin materials of the coin. Oscillation coils comprising an oscillator are arranged along a coin passage, and impart a low-frequency induced magnetic flux and, subsequently, a high-frequency-induced magnetic flux to the coin, while it is being conveyed.

[0006] A machine disclosed in Japanese Patent Laid-Open No. 3-180992 (hereinafter referred to as the "second prior art") and in WO-A-9 103 032 is also known.

[0007] The second prior art is virtually comprised of transmitting and receiving coils, and an oscillator. The transmitting coil is disposed opposite to the receiving coil with a coin passage lying therebetween, and the oscillator is arranged to alternatively apply currents of different frequencies to the transmitting coil. Like the first prior art, the second prior art also gave consideration to the fact that as the frequency of the current applied is increased, the induced flux will no longer penetrate the coin, and improved on this finding.

[0008] However, the afore-described prior art examples have the following problems.

[0009] With the first prior art, because a plurality of oscillation coils are arranged along the coin passage, it is not possible to determine whether to accept another coin until the coin being conveyed has passed the last oscillation coil after having passed the first oscillation coil. It is also necessary to extend the coin passage accordingly in the direction of coin movement. Thus, in the former case, the time required to make a decision after a coin is loaded, that is, the decision time period would become relatively long. As a result, there may be cases where the time between the decision to accept a coin and the activation of an acceptance mechanism, such as an acceptance gate, would not be enough; to secure sufficient time for that purpose, it would be necessary to extend the distance from the oscillation coil to the acceptance mechanism. Consequently, the entire coin sorting machine would become inevitably bulky. Furthermore, the latter case would also cause a similar problem associated with bulky size of a coin sorting machine, as its coin passage is elongated.

[0010] With the second prior art, because coins are sorted by a pair of transmitting and receiving coils, the problem associated with bulky size as with the first prior art is eliminated. However, the oscillator configured to alternatively apply currents of different frequencies to the transmitting coil is complex in structure and expensive, which calls for further improvement.

[0011] Accordingly, it is an object of the present invention to provide an inexpensive, high-performance coin sorting machine, such that its size is reduced by minimizing the decision time, i.e., allowing a plurality of coils to determine the coin simultaneously, and a simple oscillation circuit is used to provide oscillation at different frequencies.

[0012] In order to solve the afore-described problems of the prior art examples, the inventors attempted to conduct various tests by arranging a plurality of coils. More specifically, instead of arranging a plurality of coils along the coin passage, the coils are classified into two categories: inner coils with a smaller diameter and outer coils with such a diameter that they surround the inner coils; as these coils are combined, the connection mode for the inner coils with each and the outer coils with each other is selected, and currents with different frequencies consisting of low frequency (LF) and high frequency (HF) are applied to each coil. The results were observed in detail.

[0013] By observing the connection modes, the inventors reached the following conclusion. When the inner coils and outer coils are connected in the same mode, i.e., when the inner coils are connected in a cumulative connection mode (differential connection mode) and the outer coils are also connected in the cumulative connection mode (differential connection mode), the resulting waveform was disturbed regardless of the frequencies applied to both coils, so that changes in impedance induced by the passage of a coin could not be detected accurately.

[0014] It should be noted that the term "cumulative connection" used herein means that the magnetic flux generated by one coil is added to the flux generated by another coil, and the term "differential connection" means that the magnetic flux generated by one coil is cancelled by the flux generated by another coil.

[0015] On the other hand, if the inner coils are con-

nected to each other in the differential connection mode as shown in Fig. 4(1), and the outer coils are connected differently in the cumulative connection mode as shown in Fig. 4(2), then variations in impedance could be read acceptably, as shown in Fig. 10. Conversely, the inner coils are connected in the cumulative mode and the outer coils are connected in the differential mode, changes in impedance could also be read acceptably (not shown). It should be noted that the arrows shown in Fig. 4 denotes magnetic lines of flux.

[0016] Next, with the relationship between LF and HF in mind, the inventors conducted tests to determine how closely they could be brought together, while changing combinations of both frequencies. The results indicate that when HF is less than 2LF (2LF > HF), both frequencies interfere with each other so that changes in impedance could not be read acceptably. Fig. 9 shows a chart with LF of 100 kHz and HF of 140 kHz.

[0017] On the other hand, if HF is greater 2LF (2LF < HF), there would be no problem; more preferably, it was found that if 6 kHz is used for LF and 120 kHz or higher is used for HF, then no interference would occur between the two frequencies, so that the coins could be sorted acceptably.

[0018] The invention comprises a coin sorting machine as defined in claim 1.

[0019] The invention will now be described merely by way of example with reference to the accompanying drawings, in which

Fig. 1 is a cross-sectional view of a coin sorting machine according to the present invention.
Fig. 2 is a cross-sectional view along line I-I of Fig. 1.
Fig. 3 is a plan view of one coil.
Fig. 4 is a simplified view illustrating the connection mode of the coils in Embodiment 1.
Fig. 5 is a diagram depicting an electrical circuit of the coin sorting machine according to the present invention.
Fig. 6 is a diagram showing characteristic data for the coils connected in a cumulative mode.
Fig. 7 is a diagram showing characteristic data for the coils connected in a differential mode.
Fig. 8 is a simplified view illustrating the connection mode of the coils in Embodiment 2.
Fig. 9 is a diagram depicting how LF and HF interfere with each other.

Operation

[0020] As the coin loaded from the coin slot is moved along the coin passage, it blocks the magnetic flux generated by the sensor coils, thereby causing changes in impedance of the sensor coils. Then, one coil that comprises the sensor coils is set at a lower frequency so that its magnetic flux mainly penetrates into the moving coin, while the other coil is set at a higher frequency so that its magnetic flux mainly penetrates the skin of the passing coin; thus, both cause specific changes in impedance due to the materials of the passing coin. These changes are compared against the data on the coin to be accepted which is stored in the decision means, and, if the result is within a predetermined range, then it is determined that the passing coin is to be accepted, and if not, it is to be rejected.

[0021] Embodiments of a coin sorting machine according to the present invention will be described hereinbelow with reference to the accompanying drawings.

Embodiment 1

[0022] This coin sorting machine is built into, for example, various types of vending and game machines, and its simplified front cross-sectional view is shown in Fig. 1. In Fig. 1, the size of sensor coils and so forth is exaggerated for ease of understanding.

[0023] A coin sorting machine 1 is comprised of a coin slot 3 into which a coin 2 denoted by a virtual line is loaded (hereinafter referred to as the "loaded coin"), a coin passage 4 along which the loaded coin is rolled, a coin passage gate 5 provided in the downstream section of the coin passage 4, and sensor coils 6 facing the sides of the loaded coin that is rolling along the coin passage 4.

[0024] Fig. 2 shows a cross-sectional view along line I-I of Fig. 1. Here, the sensor coils 6 consist of a pair of coils 6a and 6b arranged opposite to each other with the coin passage 4 lying therebetween. Fig. 3 shows the state of one coil 6a as viewed from the coin passage 4 (direction of arrow A in Fig. 2). It should be appreciated that the coils 6a and 6b may not necessarily be of the same shape; however, in the present embodiment, because the other coil 6b is structured in the same shape as the coil 6a, only the first coil 6a will be described herein.

[0025] The one coil 6a consists of a first inner coil $6a_1$ and a first outer coil $6a_2$ surrounding the first inner coil $6a_1$, both being circular in shape and wound concentrically; and both coils are placed in a circular ferrite core 7. It should be appreciated that the sensor coils 6 and ferrite core 7 may not be circular in shape, but any other shape may be used.

[0026] The center of the first inner coil $6a_1$ and first outer coil $6a_2$ may be arranged so that the trajectory followed by the center of the loaded coin rolling along the coin passage 4 follows that center. The distance from the sensor coil to the coin passage gate 5 needs to be optimized relative to the operating time of a solenoid (not shown) that actuates the coin passage gate 5, although it may be reduced according to a reduction in the coin determination time, as compared to cases where multiple sets of sensor coils are arranged along the coin passage.

[0027] Next, the connection modes of the coils are described. The inner coils or the outer coils will not be connected to each other in the same connection mode, that

is, both will not be connected in the same cumulative or differential mode. This is intended to prevent both the inner and outer coils from interfering with each other, so that if one is connected in the cumulative mode, the other will be connected in the differential mode.

[0028] This will be explained in greater detail with reference to Fig. 4. Figs. 4 (1) and (2) illustrate the flow of currents I_1 and I_1 flowing through the first outer coil and the first inner coil, respectively, at a moment, and the resulting magnetic flux. In Fig. 4 (1), both the outer coils are wound in the same direction, i.e., connected in the cumulative mode, so that the magnetic flux generated by the first and second outer coils is added to each other.

[0029] In Fig. 4 (2), on the other hand, both inner coils are wound in different directions, i.e., connected in such a manner that the magnetic flux produced by the first inner coils is canceled by the magnetic flux produced by the second inner coil. It should be appreciated by those skilled in the art that by reversing the connection modes of the present embodiment, that is, by connecting the outer coils and the inner coils in the differential and cumulative modes, respectively, similar effects will be achieved.

[0030] Next, the relationship between LF and HF is described with reference to Figs. 6 and 7.

[0031] Fig. 6 shows the state where the first and second inner coils are connected to each other in the cumulative mode, and Fig. 7 shows the state where the first and second outer coils are connected to each other in the differential mode. With the graphs in those figures, the horizontal axis denotes the oscillation frequency, and the vertical axis represents the voltage. The voltage of the oscillation circuit with no coin loaded is set to 1 V, and both figures show how the voltage drops when the coin made of materials indicated in those figures is loaded.

[0032] As the materials of the loaded coin, copper, aluminum, brass, iron, lead, nickel silver (an alloy of nickel, copper and zinc, plated with silver), and stainless steel were used in the present embodiment.

[0033] First, turning to the graph in Fig. 6, when the oscillation frequency is set near 30 kHz, the voltage changes substantially in order of copper, aluminum, brass, iron, lead, nickel silver, and stainless steel. Turning to the graph in Fig. 7, on the other hand, when the oscillation frequency is set near 60 kHz, the voltage changes substantially in order of stainless steel, nickel silver, lead, aluminum, brass and iron. In this case, the former is connected in the cumulative mode, while the latter is connected in the differential mode; by reversing these modes, that is, by connecting the former in the differential mode and the latter in the cumulative mode, similar values were observed. This suggests that if one pays attention only to stainless steel, the material with the most substantial change observed when connected in the cumulative mode exhibits the least substantial change when connected in the differential mode. In this way, prominent changes in voltage can be read by selecting the oscillation frequency and connection mode as appropriate.

[0034] In the present embodiment, a frequency near 30 kHz is used as LF (in the cumulative connection mode), while a frequency near 180 kHz is used as HF (in the differential connection mode). Such frequencies are used because if HF is set at twice LF, then changes in voltage are well exhibited without mutual interference of these frequencies. Tests conducted by the inventors found that it would be desirable to use a frequency ranging from 10 kHz to 200 kHz as LF and accordingly use a frequency higher than 200 kHz as HF.

[0035] Next, the process flow for determination of the loaded coin is described with reference to Fig. 5.

[0036] The coin characteristics data detected by a first oscillation circuit 11 a including the first sensor coil 6a and a second oscillation circuit 11b including the second sensor coil 6b is inputted into a CPU 14 via a rectifier circuit 12 and an A/D converter 13. The coin characteristics data inputted is stored in the CPU 14 and also sent to decision means 15. The decision means 15 compares the coin characteristics data against normal coin data provided by storage means 16 that stores the data on coins to be accepted, and determines whether the result falls within a predetermined range, and sends the decision result to the CPU 14.

[0037] If the decision result sent falls within a predetermined range, that is, if the loaded coin is a coin to be accepted, then the CPU 14 issues an OPEN GATE command to gate control means 17, thereby opening a gate 5, so that the loaded coin is guided toward a coin acceptance chute (not shown).

[0038] On the other hand, if the loaded coin is not a coin to be accepted, the gate 5 is not opened because the OPEN GATE command is not issued, so the loaded coin is guided toward a coin rejection chute (not shown).

Embodiment 2

[0039] In Embodiment 2, the shape of the sensor coils is different, although its fundamental operation is similar to that of Embodiment 1. More specifically, it is similar to Embodiment 1 in that one coil 6c and the other coil 6d are arranged opposite to each other with the coin passage lying therebetween as shown in Fig. 8. The one coil 6c consists of a first coil $6c_1$ and a first overlapping coil $6c_1$. The first overlapping coil $6c_1$ is disposed in such a position that it is separated away from the coin passage in the thickness direction of the first coil $6c_1$. The other coil 6d consists of a second coil $6d_1$ and a second overlapping coil $6d_1$. The second overlapping coil $6d_1$ is disposed in such a position that it is separated away from the coin passage 4 in the thickness direction of the second coil $6d_1$. The connection mode and oscillation frequency for each coil are similar to those of Embodiment 1.

[0040] In Embodiment 2, the first coil $6c_1$ and first overlapping coil $6c_1$ that comprise the one coil 6c, and

the second coil $6d_1$ and second overlapping coil $6d_1$ that comprise the other coil 6d are shaped concentrically and with the same diameter, but they may not be limited thereto. The coil of either of the combinations may be shaped in similar figures.

Claims

1. A coin sorting machine comprising:

   a coin slot and a coin passage (4) along which a coin can roll when inserted into the coin slot; sensor coils (6a,6b) located on opposite sides of the coin passage;

   characterised in that:

   a first sensor coil (6a) on one side of the passage (4) includes an inner coil (6a1) mounted concentrically adjacent an outer coil (6a2);

   a second sensor coil (6b) on the other side of the passage (4) includes an inner coil (6b1) mounted concentrically adjacent an outer coil (6b2);

   said first inner coil (6a1) and said second inner coil (6b1) are connected in one of a cumulative mode and a differential mode, and said first outer coil (6a2) and said second outer coil (6b2) are connected in the other of said cumulative mode and said differential mode.

2. A coin sorting machine according to claim 1, including:

   oscillator circuitry (11a,11b) connected to the sensor coils (6a,6b); signal processing means (13,14) for processing signals from the sensor coils (6a,6b) to determine characteristics of the inserted coin; and decision means (15,16) for comparing the characteristics of the inserted coin with normal coin data , whereby coins are accepted or rejected;

   and wherein the first sensor coil (6a) is directly opposite the second sensor coil;

   the outer coils (6a2,6b2) are wound in the same direction, and the inner coils (6a1,6b2) are wound in opposite directions; and

   means are provided for interchangeably connecting the inner coils (6a1,6b1) in either the cumulative mode, in which the magnetic flux of the inner coils is added together, or the differential mode, in which the flux of one of the inner coils cancels the flux of the other inner coil; said means also connecting the outer coils in either a differential mode, or a cumulative mode, so that the inner and outer coils are not connected in the same mode at the same time;

   the frequency of the signal supplied to the inner coils in the differential mode is more than twice that supplied to the outer coils in the cumulative mode , or vice versa.

3. A coin sorting machine according to claim 1 or 2, wherein each inner coil (6a1, 6b1) is surrounded concentrically by the respective outer coil (6a2,6b2).

4. A coin sorting machine according to claim 1 or 2, wherein each inner and outer coil (6a1,6b1; 6a2/6b2) is located concentrically on a common axis in the thickness direction of the coils and the inner coils (6a1,6b1) are mounted between the coin passage (4) and the respective outer coil (6a2,6b2).

5. A coin machine according to claim 1, 2 or 3, wherein the inner coils (6a1,6b1) and outer coils (6a2,6b2) are mounted in an annular recess within a ferrite core (7).

Patentansprüche

1. Münzsortiermaschine, die folgendes umfasst:

   einen Münzschlitz und eine Münzpassage (4), entlang der eine Münze rollen kann, wenn sie in den Münzschlitz eingeführt wird; Sensorspulen (6a, 6b), die sich an gegenüber liegenden Seiten der Münzpassage befinden;

   dadurch gekennzeichnet, dass

   eine erste Sensorspule (6a) an einer Seite der Passage (4) eine innere Spule (6a1) enthält, die konzentrisch benachbart zu einer äußeren Spule (6a2) montiert ist;

   eine zweite Sensorspule (6b) auf der anderen Seite der Passage (4) eine innere Spule (6b1) enthält, die konzentrisch benachbart zu einer äußeren Spule (6b2) montiert ist;

   die erste innere Spule (6a1) und die zweite innere Spule (6b1) in einem Modus eines kumulativen Modus oder eines differenziellen Modus verbunden sind und die erste äußere Spule (6a2) und die zweite äußere Spule (6b2) in dem anderen Modus des kumulativen Modus und des differenziellen Modus verbunden sind.

2. Münzsortiermaschine nach Anspruch 1, die folgendes enthält:

eine Oszillatorschaltung (11a, 11b), die mit den Sensorspulen (6a, 6b) verbunden ist; eine Signalverarbeitungseinrichtung (13, 14), um Signale von den Sensorspulen (6a, 6b) zu verarbeiten, um Charakteristiken der eingeführte Münze zu bestimmen, und eine Entscheidungseinrichtung (15, 16), um die Charakteristiken der eingeführten Münze mit normalen Münzdaten zu vergleichen, wodurch Münzen akzeptiert oder zurückgewiesen werden;
und wobei die erste Sensorspule (6a) direkt gegenüber liegend der zweiten Sensorspule ist;
die äußeren Spulen (6a2, 6b2) in derselben Richtung gewunden sind und die inneren Spulen (6a1, 6b2) in gegenüber liegende Richtungen gewunden sind; und
eine Einrichtung vorgesehen ist, um austauschbar die inneren Spulen (6a1, 6b1) in entweder dem kumulativen Modus, in dem der magnetische Fluss der inneren Spulen zusammengefügt wird bzw. addiert wird, oder dem differenziellen Modus, in dem der Fluss einer der inneren Spulen den Fluss der anderen inneren Spule auslöscht, verbunden sind; wobei die Einrichtung auch die äußeren Spulen in entweder einem differenziellen Modus oder einem kumulativen Modus verbindet, so dass die innere und äußere Spule nicht in demselben Modus zur selben Zeit verbunden sind;
die Frequenz des Signals, das zu den inneren Spulen in den differenziellen Modus zugeführt wird, mehr als doppelt so hoch ist als jene, die zu den äußeren Spulen in dem kumulativen Modus zugeführt wird oder umgekehrt.

3. Münzsortiermaschine nach Anspruch 1 oder 2, bei welcher jede innere Spule (6a1, 6b1) konzentrisch durch die jeweilige äußere Spule (6a2, 6b2) umgeben ist.

4. Münzsortiermaschine nach Anspruch 1 oder 2, bei welcher sowohl die innere als auch äußere Spule (6a1, 6b1; 6a2, 6b2) konzentrisch auf einer gemeinsamen Achse in der Dickenrichtung der Spulen sich befindet und die inneren Spulen (6a1, 6b1) zwischen der Münzpassage (4) und der jeweiligen äußeren Spule (6a2, 6b2) montiert sind.

5. Münzmaschine nach Anspruch 1, 2 oder 3, bei welcher die inneren Spulen (6a1, 6b1) und äußeren Spulen (6a1, 6b1) in einer ringförmigen Vertiefung innerhalb eines Ferritkerns (7) montiert sind.

Revendications

1. Machine pour trier des pièces de monnaie, comprenant :

une fente pour les pièces de monnaie et un passage (4) pour les pièces de monnaie, le long duquel une pièce de monnaie peut rouler lorsqu'elle est insérée dans la fente pour pièces de monnaie; des bobines de détection (6a,6b) étant disposées sur des côtés opposés du passage des pièces de monnaie;

caractérisée en ce que

une première bobine de détection (6a) située d'un côté du passage (4) inclut une bobine intérieure (6a1) montée concentriquement au voisinage d'une bobine extérieure (6a2) ;

une seconde bobine de détection (6b) de l'autre côté du passage (4) inclut une bobine intérieure (6b1) montée concentriquement au voisinage d'une bobine extérieure (6b2) ;

ladite première bobine intérieure (6a1) et ladite seconde bobine intérieure (6b1) sont connectées dans l'un d'un mode cumulé et d'un mode différentiel, et ladite première bobine extérieure (6a2) et ladite seconde bobine extérieure (6b2) sont connectées dans l'autre dudit mode cumulatif et dudit mode différentiel.

2. Machine pour trier les pièces de monnaie selon la revendication 1, comprenant :

un circuit oscillant (11a,11b) connecté aux bobines de détection (6a,6b); des moyens de traitement de signaux (13,14) pour traiter des signaux provenant des bobines de détection (6a, 6b) pour déterminer des caractéristiques de la pièce de monnaie insérée, et des moyens de décision (15,16) pour comparer les caractéristiques de la pièce de monnaie insérée à des données de pièces de monnaie normales, ce qui a pour effet que les pièces de monnaie sont acceptées ou rejetées; et
dans laquelle la première bobine de détection (6a) est située directement en vis-à-vis de la seconde bobine de détection;
les bobines extérieures (6a2,6b2) sont enroulées dans la même direction et les bobines intérieures (6a1,6a2) sont enroulées dans des directions opposées; et
des moyens sont prévus pour connecter d'une manière interchangeable des bobines (6a1,6a2) soit dans le mode cumulé, dans lequel le flux magnétique des bobines intérieures est ajouté conjointement, ou le mode différentiel, dans lequel le flux de l'une des bobines intérieures annule le flux de l'autre bobine intérieure; lesdits moyens raccordant également les bobines extérieures dans l'un du mode différentiel ou du mode cumulé, de sorte que les bobines intérieure et extérieure ne sont pas connectées dans le même mode au même mo-

ment;
la fréquence du signal envoyé aux bobines intérieures dans le mode différentiel étant supérieure au double de celle envoyée aux bobines extérieures dans le mode cumulé, ou vice versa.

3. Machine pour trier des pièces de monnaie selon la revendication 1 ou 2, dans laquelle chaque bobine intérieure (6a1,6b1) est entourée concentriquement par la bobine extérieure respective (6a2,6b2).

4. Machine pour trier des pièces de monnaie selon la revendication 1 ou 2, dans laquelle chaque bobine intérieure et chaque bobine extérieure (6a1,6b1; 6a2,6b2) est disposée concentriquement sur un axe commun dans le sens de l'épaisseur des bobines, et les bobines intérieures (6a1,6b1) sont montées entre le passage (4) des pièces de monnaie et la bobine extérieure respective (6a2,6b2).

5. Machine pour trier des pièces de monnaie selon la revendication 1, 2 ou 3, dans laquelle les bobines intérieures (6a1,6b1) et les bobines extérieures (6a2,6b2) sont montées dans un renfoncement annulaire à l'intérieur d'un noyau de ferrite (7).

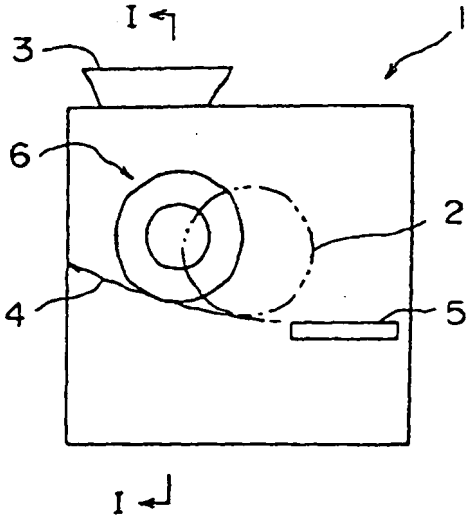


Fig. 1

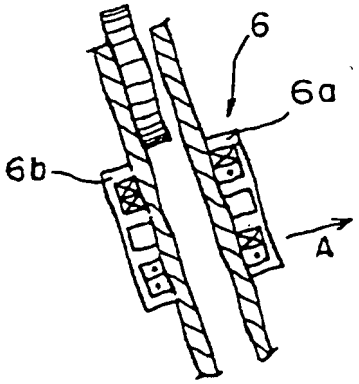


Fig. 2

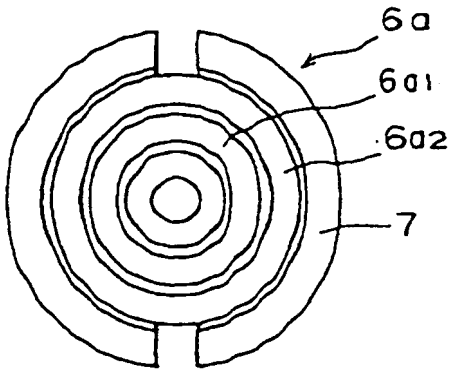
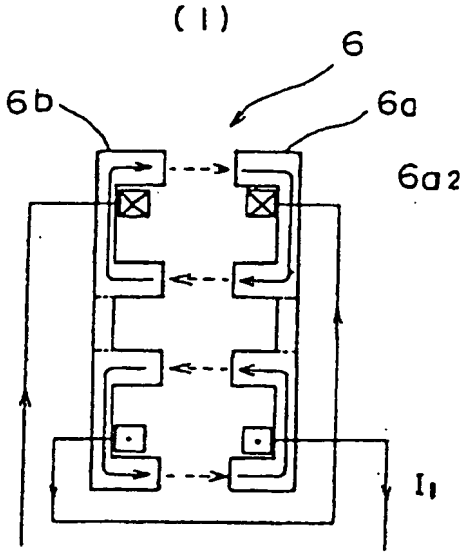


Fig. 3



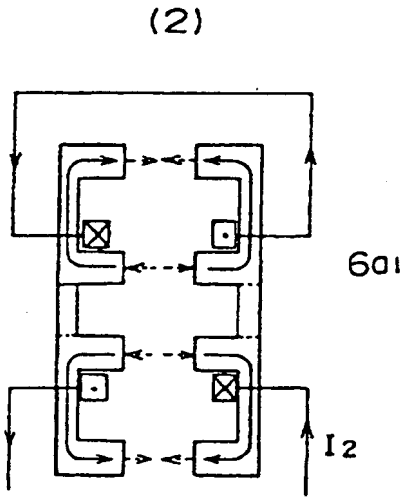


Fig. 4

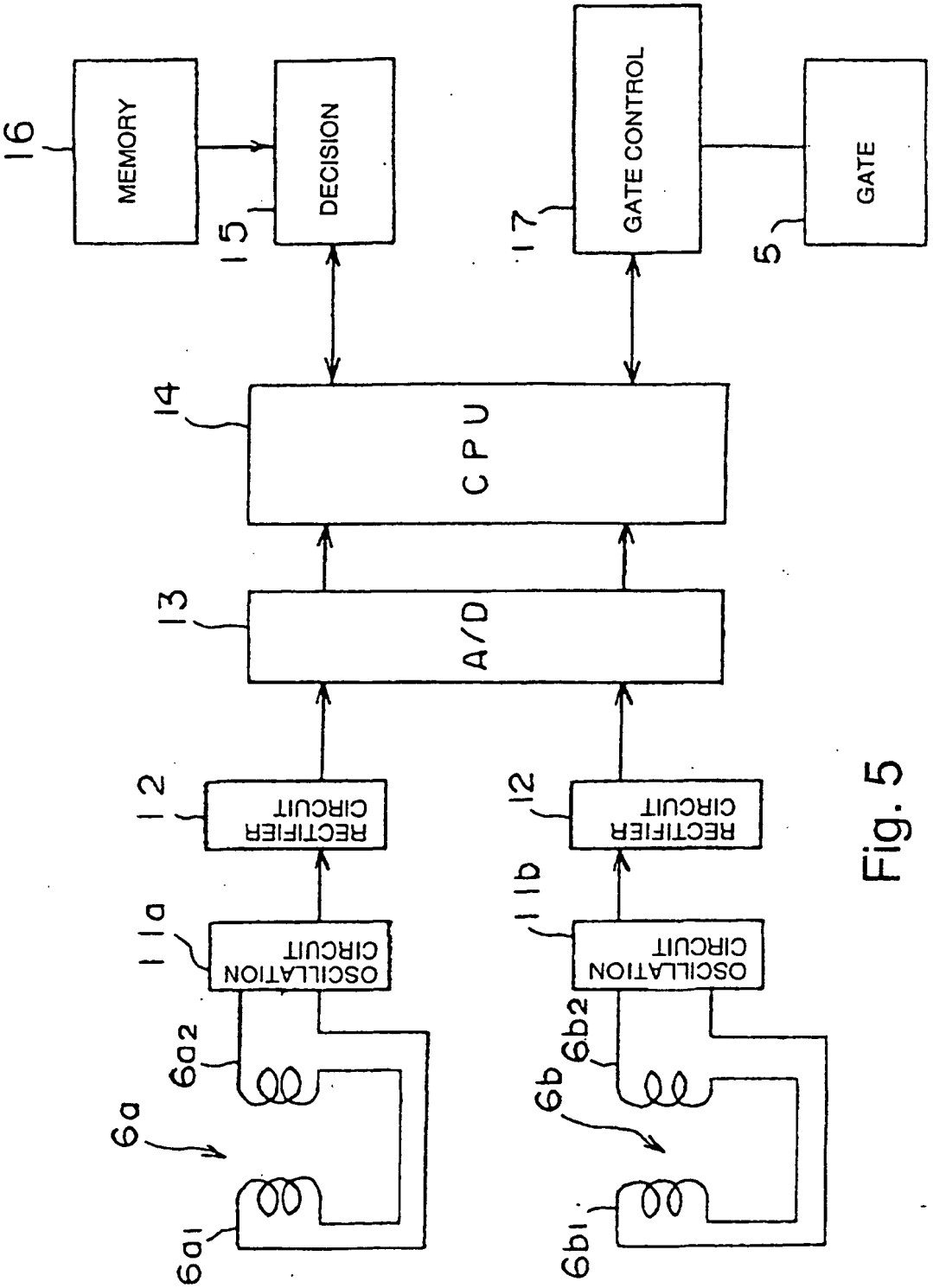

16
MEMORY
DECISION
15
17
GATE CONTROL
GATE
5
14
CPU
13
A/D
12
RECTIFIER CIRCUIT
12
RECTIFIER CIRCUIT
11a
OSCILLATION CIRCUIT
11b
OSCILLATION CIRCUIT
6a2
6a
6a1
6b2
6b
6b1

Fig. 5

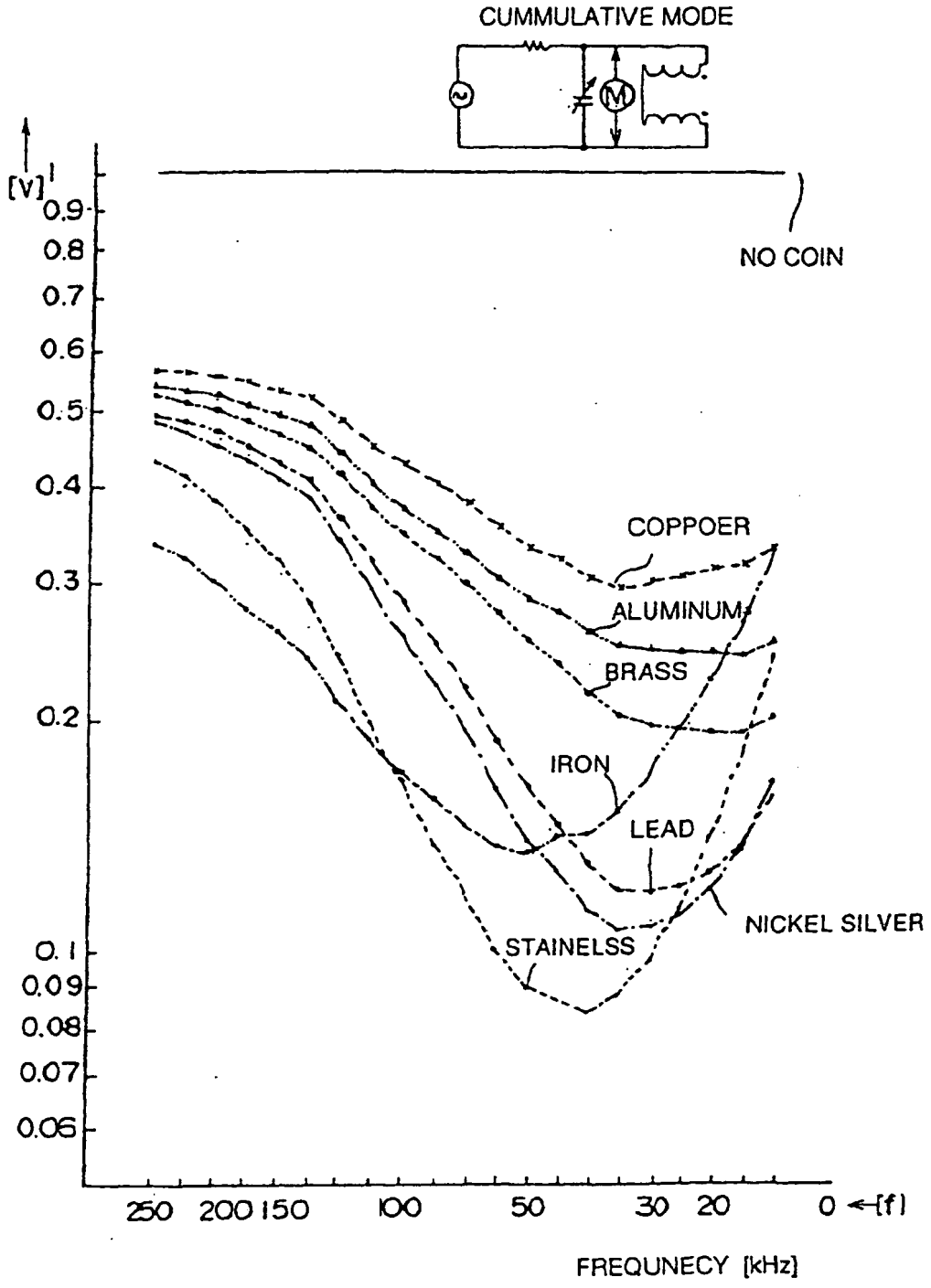

CUMMULATIVE MODE
[V]
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.09
0.08
0.07
0.06
NO COIN
COPPOER
ALUMINUM
BRASS
IRON
LEAD
NICKEL SILVER
STAINELSS
250
200
150
100
50
30
20
0
[f]
FREQUNECY [kHz]

Fig. 6

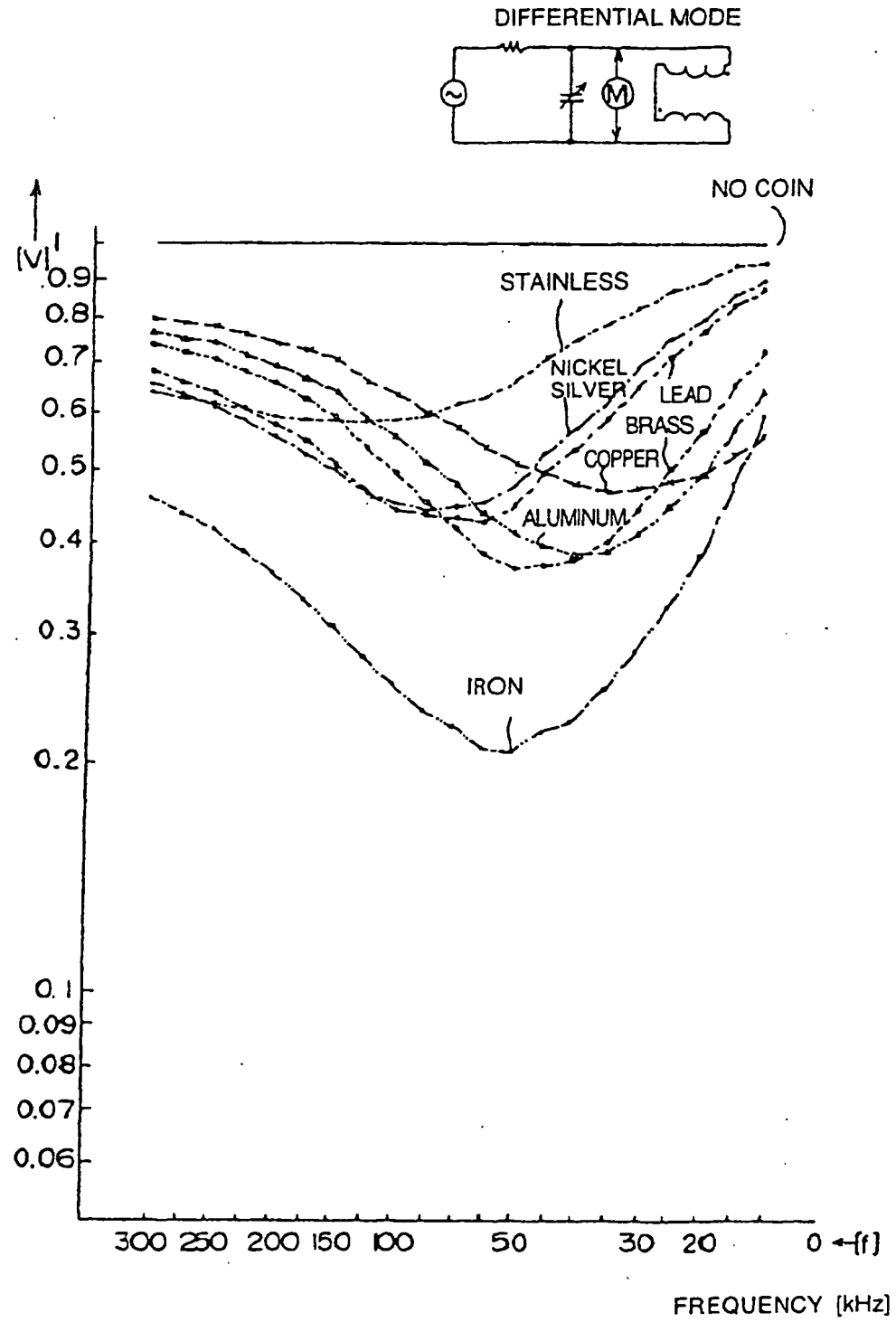

DIFFERENTIAL MODE
NO COIN
[V]
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.09
0.08
0.07
0.06
STAINLESS
NICKEL SILVER
LEAD
BRASS
COPPER
ALUMINUM
IRON
300 250 200 150 100 50 30 20 0 ←[f]
FREQUENCY [kHz]

Fig. 7

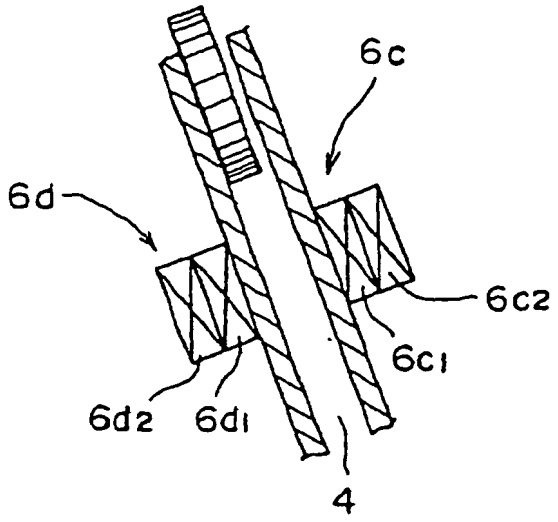


Fig. 8

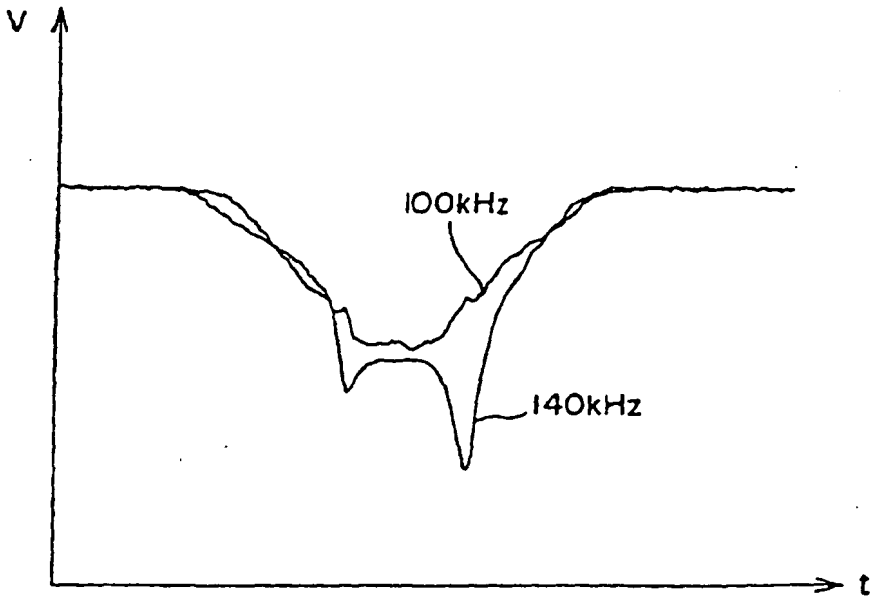


Fig. 9